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WINTER DIET OF LONG-EARED OWLS (*ASIO OTUS*) IN THE PO PLAIN (NORTHERN ITALY)

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KEY WORDS: *food habits; diet; Italy; long-eared owl*; Asio otus.

The winter diet of the long-eared owl (*Asio otus*) has been well documented in northern and central Europe and North America (see Cramp 1985 for review), but there are few data for southern Europe and particularly Italy. In northern Europe, the long-eared owl specializes in hunting voles (*Microtus* spp.) in open fields (Herrera and Hiraldo 1976), and it is considered a restricted feeder (Marti 1976, Källander 1977, Nilsson 1981). Likewise, in the Mediterranean region voles are the most important component in the diet of long-eared owls (Araujo et al. 1973, Tome 1991). Only three studies (Gerdol and Perco 1977, Casini and Magnaghi 1988, Canova 1989) have reported the diet and prey selection of long-eared owls in the Po Plain of northern Italy, which is the most important part of their Italian wintering and breeding range (Galeotti 1990).

In this paper, we review the diet of long-eared owls in the Po Plain to: (1) provide new information on the trophic niche of southern wintering populations of long-eared owls, (2) compare local diets, and (3) determine the hunting habitats most utilized by the species.

STUDY AREAS AND METHODS

This area has a sublittoral continental temperate climate with two peaks of rainfall in spring and autumn; during winter the mean temperature ranges from 0–10°C and precipitation averages 50–60 mm monthly.

Pellets were collected between January and March from eight winter roosts located in the Po Plain. Roosts 1, 2, and 3 (Table 1) were close to the eastern edge of the study area, a few kilometers from the Adriatic Sea, while all other roosts were located in Lombardy, the central part

Table 1. Winter diets of the long-eared owl from eight winter roosts on the Po Plain of northern Italy (*N*% = dietary frequency by number, B% = dietary frequency by biomass).

	Collection Sites																	
	1[a]		2[b]		3[c]		4[d]		5[e]		6[f]		7[c]		8[g]		Total	
Prey	*N*%	B%	*N*%	B%	*N*%	B%	*N*%	B%	*N*%	B%	*N*%	B%	*N*%	B%	*N*%	B%	*N*%	B%
Insecta	0	0	0	0	0.2	0.01	0	0	0	0	0	0	0	0	0.8	0.05	0.2	0
Aves	11.7	13.4	4.1	4.8	3.9	4.9	23.6	21.0	54.5	49.9	3.4	4.4	10.3	8.4	3.1	3.6	10.2	9.4
Mammalia	88.3	86.6	95.9	95.2	96.0	95.1	76.3	79.0	45.5	50.1	96.6	95.6	89.7	91.6	96.5	96.4	89.6	90.5
Neomys fodiens	0	0	0	0	0	0	0	0	0	0	0.7	0.7	0	0	0.1	0.1	0.1	0.03
Suncus etruscus	0	0	0	0	0.2	0.02	0	0	0	0	0	0	0	0	0	0	0.1	0.01
Crocidura leucodon	0	0	0	0	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0.1	0.1
Crocidura suaveolens	0	0	0	0	2.0	0.9	0.9	0.2	0	0	0	0	0.5	0.2	0	0	0.9	0.2
Arvicola terrestris	0.8	1.9	0	0	0	0	0.3	0.8	0	0	0.7	4.9	0	0	0	0	0.2	0.5
Clethrionomys glareolus	0	0	0	0	0	0	1.5	1.9	0	0	3.4	5.2	2.5	3.4	0.7	1.0	0.7	0.9
Microtus multiplex	1	0.7	0	0	0	0	0	0	0	0	0.7	0.7	1.5	1.4	2.1	2.1	0.7	0.6
Microtus savii	0	0	2.5	2.0	36.8	36.9	9.9	9.2	15.8	16.1	7.5	8.5	13.8	14.2	12.9	13.6	18.3	18.8
Microtus arvalis	17.4	14.2	40.5	37.0	0	0	0	0	0	0	0	0	0	0	0	0	3.3	3.1
Microtus spp.	0	0	8.3	7.2	0	0	0	0	10.9	10.9	1.4	1.5	6.4	6.4	2.1	2.2	1.4	0.4
Muscardinus avellanarius	0	0	0	0	0	0	0.3	0.4	0	0	0	0	0	0	0.4	0.5	0.1	0.2
Micromys minutus	8.6	2.4	5.8	1.8	1.2	0.4	12.6	2.8	2.0	0.6	37.4	12.7	6.4	2.0	20.7	6.6	10.2	2.3
Apodemus agrarius	5.7	7.0	5.8	7.9	0	0	0	0	0	0	0	0	0	0	0	0	0.8	1.1
Apodemus sylvaticus	40.0	41.1	29.7	34.5	46.4	49.5	48.5	53.7	5.0	5.3	25.2	30.1	36.0	39.1	41.6	46.5	41.8	48.5
Rattus rattus	1.3	3.7	0.8	2.6	0.2	0.5	0	0	0	0	0	0	0	0	0	0	0.2	0.9
Rattus norvegicus	1.8	7.4	0	0	0.2	1.0	2.4	10.1	1.0	5.4	1.4	9.7	0	0	1.4	8.1	1.1	4.8
Mus domesticus	3.9	2.4	0	0	8.8	5.7	0	0	0	0	1.4	1.0	0	0	2.1	1.4	3.8	2.7
Muridae spp.	7.8	5.7	2.5	2.0	0	0	0	0	2.0	2.3	4.8	6.1	3.9	4.6	4.3	5.2	2.3	2.6
Unidentified mammals	0	0	0	0	0	0	0	0	8.9	9.5	12.2	14.6	18.7	20.3	8.0	8.9	3.5	3.2
Prey number	385		121		1157		668		101		147		203		717		3499	
Mean prey weight (g)	—		—		24.1		20.9		18.7		16.8		18.8		17.9		21.5	
Diet breadth	0.51		0.38		0.38		0.47		0.44		0.60		0.66		0.57		0.56	

[a] Farmland/woodlots.
[b] Hilly woods.
[c] Farmland/hedgerow.
[d] Willow/farmland.
[e] Urban.
[f] Ricefields/woodlots.
[g] Farmland/ricefields.

of the Po Plain. Roosts were between 25–450 km apart. The habitat types surrounding each roost (2.5 km radius) are reported in Table 1.

Although the long time span over which pellets were collected (16 yr) could be responsible for variation in local diets, we found no evidence of fluctuations in small rodent populations in northern Italy among years (L. Canova unpubl. data). Moreover, there is evidence that some vole species living in Mediterranean regions are not cyclic (Paradis and Guedon 1993). Finally, the diet of long-eared owls can be more variable between seasons than between years (Nilsson 1981). Therefore, we believe that, taken together, these findings justify our tentative comparison among local diets irrespective of the years in which pellets were collected.

All pellets were examined using standard techniques (Yalden 1977). Prey remains were identified using taxonomic keys (Erome and Aulagnier 1982), and reference specimens collected in the study areas. Because few workers have identified birds to species in dietary studies we considered them as a single category. Because they were all small passerines (mainly *Passer* spp.), we used a mean mass of 20 g for biomass calculations. Small mammal biomass was derived from the literature (Di Palma and Massa 1981, Galeotti et al. 1991). Frequency by number and biomass for each prey species and the mean mass of prey were calculated for diets at each roost.

Diet breadth (based on frequencies of ecological prey-categories) was determined by the index: $B = 1/R\ \Sigma p_i^2$ (Feinsinger et al. 1981) where p is the proportion of the prey i in the total sample and R is the number of prey categories collected at each station; the B-index varies from 0 (no use of any resource) to 1 (full use of total resources).

RESULTS AND DISCUSSION

Overall Diet. We identified 3499 prey items that amounted to a total biomass of 75 466 g. Prey included mammals (89.6%), birds (10.2%) and insects (0.2%). Although long-eared owls preyed on 16 mammal species from four families, three species (*Apodemus sylvaticus, Microtus savii,* and *Micromys minutus*) accounted for 64.8% of the diet and murid rodents predominated overall (Table 1) The mean mass of prey (21.5 g) was lower than that calculated (32.2 g) by Marti (1976) from a number of European studies; consequently, the average meal was also slightly lower (51.8 g) than that reported from a number of diets in northern Europe and North America (55–60 g)

Local Diets and Feeding Habitats. Diets differed in type and proportion of mammal prey species. Murids were the most important prey category at all but two roosts. Microtids were the second most common prey used by long-eared owls at all roosts but one, and they were preyed on more heavily at eastern sites. Birds were preyed on at all roosts, but predominated in the diet of long-eared owls in the urban roost and in willow/farmland. The importance of birds in owl's diet at one roost was related to weather: the frequency of bird prey increased in relation to the snow cover, ranging from 13–14% when snow was absent to 42% when snow covered the ground (Canova 1989). Niche breadth increased in relation to an increase in woodland species ($r_s = 0.92$, $P < 0.01$) which were rare prey in the diets. The frequency of farmland species in the diet (*Rattus rattus, Apodemus agrarius,* and *Microtus arvalis*) increased toward the east, while woodland species (*Clethrionomys glareolus,* and *Microtus multiplex*) were preyed on more often at western sites. This was consistent with the localized distribution of *Clethrionomys glareolus* which is locally abundant in wooded habitats in the western portion of the Po Plain, but scattered or absent in the East (Canova et al. 1991). Hygrophilous species were also mainly exploited in western locations (roosts 4, 6, and 8), where numerous ditches and canals were associated with ricefields.

CONCLUSIONS

The diet of wintering long-eared owls in the Po Plain consisted mainly of mice, whereas elsewhere in Europe long-eared owls prey mainly on voles (Saint Girons and Martin 1973, Araujo et al. 1973, Glue and Hammond 1974, Marti 1976, Källander 1977, Tome 1991). This difference was probably due to both a lower richness in vole species (only eight of the 20 European Microtidae species occur in Italy) and low population levels in southern Europe compared to the North (Herrera and Hiraldo 1976). Moreover, the number of vole species decreases across the Po Plain from east to west, with only four species being present in the west (Niethammer and Krapp 1982). Voles are scarcer than mice in most habitats except in scrubs and woods (Canova and Fasola 1991, P. Galeotti and L. Canova unpubl. data). The apparently close relationship between diet composition and prey availability confirms the trophic plasticity of long-eared owls in their Italian winter range (Canova 1989).

RESUMEN.—La dieta de *Asio otus* invernantes fue estudiada en Po Plain al norte de Italia, a través de análisis de egagrápilas obtenidas desde ocho perchas de descanso invernal. En contraste con lo que ocurre en el norte y centro de Europa, los ratones predominaron por sobre las ratas de aqua. La composición dietaria sugirio que las tierras de cultivo eran los hábitat de alimentación prevalecientes alrededor de las perchas. La variación dieteria desde presas de mamiferos a aves puede ocurrir en condiciones climáticas adversas (nieves otoñales) o en hábitat urbanos.

[Traducción de Ivan Lazo]

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REFINEMENTS TO SELECTIVE TRAPPING TECHNIQUES: A RADIO-CONTROLLED BOW NET AND POWER SNARE FOR BALD AND GOLDEN EAGLES

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KEY WORDS: Aquila chrysaetos; *bald eagle; bow net; capture techniques; golden eagle;* Haliaeetus leucocephalus; *power snare.*

Research and management of raptors often requires the capture of specific individuals for radiotagging or color-marking. Bloom (1987) reviewed raptor trapping techniques, including several selective methods used for eagles: cannon and rocket nets (see also Grubb 1988), the pit trap, and our bow net. Meng (1963) was first to develop a radio-controlled bow net and Bryan (1988) modified it for use with American kestrels (*Falco sparverius*). The power snare, a "manually-operated, single noose system," was developed for the selective capture of white-bellied sea-eagles (*Haliaeetus leucogaster*) by Hertog (1987).

During studies of wintering and breeding bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) in Washington, California, and Arizona (Hunt et al. 1992a, 1992b, 1992c, 1992d), we constructed a radio-controlled bow net to selectively capture eagles (Fig. 1a). We were able to completely conceal it in loose soil and operate it from distances up to 400 m. In addition, we